

ECALL SYSTEM: FRENCH A POSTERIORI EFFICIENCY EVALUATION

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ABSTRACT

An automatic emergency call system appeared on Peugeot and Citroën vehicles in France since 2003, which has been rewarded by Euro NCAP in 2010 as an advanced innovative solution. The LAB in close cooperation with the CEESAR has set up a study aiming at evaluating the effectiveness of this system. The eCall efficiency evaluation will be based on real accidents where eCall was automatically triggered. It will aim to confirm or not the assumptions given by the European Commission: 2 500 lives saved in Europe if 100% of the fleet is equipped with such a system.

Several studies using "a priori" methods were already led on eCall benefit evaluation (Trace, eImpact and LAB results). In this study, we suggest a benefit evaluation with "a posteriori" method, based on real accident cases involving vehicles equipped with eCall. For each studied case, an expert judgment is realized to qualify or not eCall vital contribution. All these judgments allow estimating system global efficiency.

Created in 2004, the specific "eCall" database contains about 3 100 automatic emergency call notifications. More than 150 variables summarize accident circumstances, involved eCall vehicle information's, feelings of people cared for by this means as well as rescue teams feedback. Four eCall efficiency can be applied for each person involved in the accident: eCall considered as not necessary, eCall considered as useful, eCall considered as urgent and eCall considered as vital. ECall is considered as useful when involved occupants were not able to prevent the rescue team and/or did not know how to be located. The system is considered as urgent when eCall is judged as useful and when the victim has severe injuries that could be degraded. ECall is considered as vital when the victim has severe injuries that could be made this victim to die.

The "eCall" database is rather new and limited in number of coded cases. It is not representative of accidents in France. Indeed, accidents are selected with regard to their interest (new vehicles, accident typologies). However, it is regularly filled with

accident cases whose number increases due to the presence of more and more PSA eCall system in Europe. Thanks to this, the "a posteriori" benefit evaluation is unique and is based, for the first time in Europe, on real life accident cases where automatic triggered eCall occurred.

This new study allows to refine the eCall system effectiveness with a 2.8 % benefit regarding fatalities. This result based on real world accidentologic data is lower than the figure initially estimated in the 2000s, which was about 5 to 6 %. Besides, this evaluation only focused on passenger cars with an assumption of 100% of equipment rate. All these surveys allow us to define a realistic effectiveness interval of this device between 3% and 10%. It represents a real additional system against road deaths and injuries, in particular for accidents occurring at night, in rural areas and involving a single vehicle. The outcome of this paper can be used for the current discussion taking place in Europe for the foreseen regulation on 112.

INTRODUCTION

For many years now, car manufacturers have devoted enormous efforts in order to improve the safety level of their vehicles. The first action line was primary safety, which purpose is to prevent the accident from happening. The second line of action, secondary safety, addresses the vehicle's occupant protection during a crash. These two action lines are still the ones receiving the most attention for safety reasons, but recently, solutions regarding the post-accident period are emerging: the eCall is at the forefront of tertiary safety. From the beginning of 2011, the emergency call service is now operational in 11 countries of Europe on both PSA Peugeot and Citroën passenger cars (except Peugeot 107, 4007 and Citroën C1, C-crosser) fitted with a telematic unit either as a standard or as an option. More than 765 000 vehicles fitted with this device, have been sold in these countries.

HOW DOES ECALL WORK?

The procedure of the telematic device can be triggered manually or automatically. In an emergency situation, the occupant of the vehicle

presses the SOS button on the telematic terminal for at least two seconds. In a severe impact, if the vehicle's pyrotechnic equipment has been triggered (airbag or seat belt pretensioner), the vehicle itself sends out the SMS message containing the basic information mentioned previously and the request for voice contact. As soon as the button is pressed or an automatic trigger happened, the telematic terminal sends an SMS message to the call centre assigned to cover the area in which the vehicle is located. This SMS message contains vital information for dealing with the emergency. As soon as the call is intercepted, these details appear immediately on the call centre operator's control screen, in the form of a customer sheet, location on a digital map, etc. In this way, the call centre operator has useful data available even before establishing direct telephone voice contact with the occupant of the vehicle.

Once voice communication has been established with the driver, the call centre operator analyses the situation more closely. Then he analyses the situation, he checks the location on various types of map, and if necessary informs the emergency services responsible for the area in which the vehicle is currently located, giving them all the information about the situation.

Depending on the situation, but only in France, the call centre operator can also call on one of the emergency doctors permanently stationed at the call centre, using a three-way conferencing system with a view to assess the situation more accurately or to give advice while waiting for help to arrive. The three-way conferencing system can also be used to take care of people travelling outside their own country. Communication can be in their own language from the call centre in the relevant country, while the local public services will, if necessary, be informed in their own language by the national centre, which covers the accident's location. At that stage, the procedure continues "on field" with the intervention of the emergency services at the scene of the accident until the people involved are taken care of face-to-face.

In all cases, if there is no response from the accident victim, the established protocol requires the call centre operator to try to make contact with the vehicle within a limited time: when the set time has elapsed, the operator has to transmit the alert to the emergency services on the basis of the information contained in the SMS message: type of vehicle, GPS coordinates of the vehicle, type of energy of the vehicle.

The advantage of this telematic architecture is the Third Party Service (TPS), which can sort out the accident and then send the emergency services only

if it is necessary. Some other eCall systems are based on this way of working (On Star-General Motors; OnCall-Volvo; BMW Assist-BMW; ...)

DATA COLLECTION

Victim interview

In this new context of an automatic emergency call system deployment, the LAB/CEESAR has set up a study to obtain experimental results about the system's operation and effectiveness and the feelings of people cared for by this means. This makes possible to compute the time saved in getting the emergency services to the scene and check the operation of the telecommunications systems and systems for locating the accident. A special questionnaire has been created for this study. It contains a score of very specific questions. The questions are listed in 4 sections:

- an accident analysis section to give details of the circumstances of the accident, place, time, number of occupants, injuries, how long the emergency services took to arrive, etc.
- a technical section to give information about how the system operated at the time of the accident, the communication between the people involved and the emergency centre, the telephone company used, etc.
- a section for the user/person involved to provide feedback.
- a section for the fire brigade to provide feedback from the accident

Even if, the eCall system is deployed in 11 European countries, this safety benefit study concerns only "French accidents".

When we are informed about accidents involving a vehicle equipped with the eCall system, we select cases whose are the most interesting (accidents with injuries, accidents at night, accidents with only one vehicle...). We try to contact the car driver. It is important to note that interviews with victims are not always easy to get (less than one victim over two answers to our appeals). Consequently, we lose many data. When we reach the driver, we follow the steps of the questionnaire mentioned above.

When the crash is severe and the damaged vehicle available, we also make an in depth study of their vehicle. Indeed, we record the deformation of the vehicle's structure to assess the energy dissipated during the crash; as well as the parts of the passenger compartment which could have injured the occupants. In addition, we make a manual test on the eCall system to verify following the vehicle structure deformation, that eCall is still triggered.

When the call centre contact the fire brigades (in France), a questionnaire is sent to them, to get information about their intervention. The aim is to get their point of view about this eCall system. All these information are saved in an anonymous Access database (this database is described in the next chapter).

Expert judgment

Following the interview realised with the accident victim, we can put forward a judgment on the different levels of usefulness of the eCall system.

Four categories have been defined. The road accidents in which, eCall is “unnecessary” for the victims. The ones where eCall is “useful” for the victims. The other ones where eCall is “urgent” for the victims. Finally the road accidents in which eCall has been judged as “vital” for the victims. Hereafter, the graph shows the sharing out of accidents according to the four specific judgments. It means that an accident where eCall has been judged as “vital” is also considered as “urgent” and “useful”. As it will see after, to judge cases as “urgent”, we include a notion of seriousness added to hypotheses, which allow us to judge an eCall “useful”.

The cases judged as “vital” are those for which, if there had not been the eCall system, the victim would have been died because of their injuries.

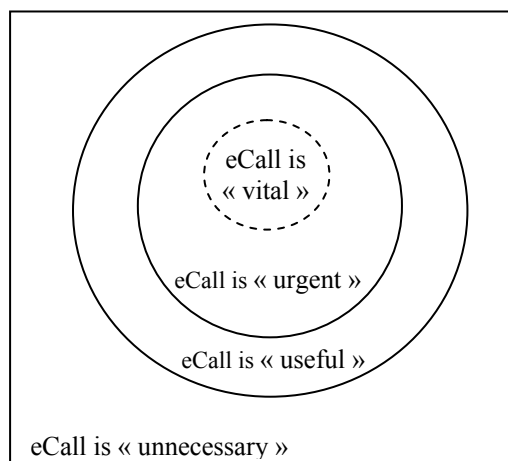


Figure 1. The sharing out of accidents according to eCall judgment.

“Unnecessary” cases The eCall system is judged unnecessary when:

- there are direct witnesses on the accident scene;
- victims are not or slightly injured and can call emergency services, ...

For example: the driver of a Peugeot 3008 follows a road with right of way in urban area, during the day. He is going to cross an intersection where the traffic lights are off. But a Renault Laguna coming from his right does not respect the road sign. The collision is unavoidable. The Renault Laguna hits with its front left side, the right side of the Peugeot 3008 (at the wheel level).

In this case, the eCall system is triggered but is considered as “unnecessary”. In fact, there are witnesses who can alert emergency services. There are two lightly injured persons (contusions) and one who is not injured. Nevertheless, the eCall system allows a quick intervention of services associated as the tow truck or the police to regulate the traffic... (non exhaustive list).



“Useful” cases To judge the eCall usefulness, some hypotheses have been expressed.

Various criteria of accidents can make the eCall useful for the victims (non exhaustive list):

- road accident with a single vehicle, by night and in a rural area;
- the car’s occupant are stuck in their car;
- nobody gets a GSM;
- car occupants don’t know the accident localization;
- the vehicle is not visible from the road;
- there is no direct or indirect witness who can call emergency services and locate himself; ...

For example: an accident occurs in a slope on a remote road in a rural area, at night. A Peugeot 407 slips on ice and crashes into a tree.

The driver is isolated and stuck in his car. He is slightly injured. He has been only shocked by the impact and a little bit hurt at neck and left shoulder.



“Urgent” cases We consider the eCall system as urgent when, with one or more criteria from the eCall useful, we add a seriously injured person in the accident:

- loss of consciousness;
- to feel faint;
- bad weather can also make the situation worse ...

For example: in a snowstorm, a Peugeot 307 slips on a slope mountain road between, Garnish and Fusen (Austria) and falls in a ditch. It rolls over and finishes on its roof, stopped by a rock (on driver door side). The driver estimates his speed at 10 km/h. In the Peugeot 307, there are three passenger’s car and only one slightly injured (broken clavicle).



A few minutes later, a Volvo car leaves the road too and realizes a glide (about ten meters) above the Peugeot 307. The Volvo lands 3 meters down below. There is one injured person in the Volvo (vertebra compression).

In this accident, the eCall system has been considered urgent, because these French tourists travelling in Austria did not know the accident place and because this eCall has permitted to help quickly the injured person involved in the Volvo car. We can see on the picture below the vehicles’ final position after the accident.

“Vital” cases A case is judged as « vital » when the serious injuries of the victims could take them to death:

- internal bleeding;
- amputation;
- all the injuries which concern the vital organs...

For example: on a minor road, in a rural area, the Peugeot 407 goes out of control at a roundabout, crosses the opposite lane, hits the kerb, then the bank, and rolls for a distance of about twenty meters. While the two passengers in the vehicle are unconscious due to the impact, the voice of the emergency call centre operator wakes the driver from his blackout. The driver answers and confirms to the emergency call centre the need of assistance



The impact was extremely violent and resulted in the partial ejection of the passenger’s head through the right-hand side window, causing serious injuries to his skull. It is certain that the rapid arrival of the emergency services saved the passenger’s head injuries from getting worse. The driver suffers from minor head injuries. This road accident with only one car, by night in a rural area makes the eCall “vital”. There is no witness and the passenger’s car was seriously injured. We can see on the picture before, the important Peugeot 407’s roof deformation.

EVALUATION METHODOLOGY

In 2010, the LAB/CEESAR carried out another study to assess the eCall efficiency; this one was called “a priori” study [1]. The data used in this evaluation were previous to the setting up of the system assessed. We used an other database coming from fatal accidents reports (called PVM2000) in France for years 2002 and 2003.

In this study, we assess the PSA Peugeot Citroën eCall system efficiency by the experience feedback of this system. This evaluation called “a posteriori” deals with events whose occur in the past. It is based on experience, on real events (here, accidents with automatic eCall triggered). This evaluation consists in study the results, the consequences of the eCall setting up. To achieve this goal, we will use the database described below (next sub-heading).

Database introduction

Created in 2004, the specific "eCall" database contains about 3100 automatic emergency call notifications, taking all countries together where eCall is deployed. As explained above, this study includes 150 variables which not only detail information about the circumstances of the accident, but also accurate assessments of occupants' injuries, expert reports on the vehicles involved and feedback on the eCall system from the fire rescue teams.

The Access database is divided into 5 tables described below.

- Accident circumstances

This table is filled in predominantly every week with the call centre accident feedback.

- Vehicle equipped with the eCall system

This table groups together the information on the PSA Peugeot Citroën vehicle equipped with the eCall (brand, model, eCall system type ...), and feedbacks coming from the manual test on the eCall system realized on the damaged vehicle.

- Car occupants

It takes into account all the information concerning occupants: age, height, weight, injuries ...

- Questionnaire to the victims

This table contains the driver answers about the questions asked during the phone call interview. This questionnaire is divided into 4 sub-parts:

Technique of eCall system (does the driver know the eCall, what was the SIM card used in the system, how long between the crash and the call ...)

Accidentology (is there some witnesses, how long between the call and the emergency services intervention ...)

Fire brigade (answered by the victim) (has the vehicle been cut by the firemen to leave an injured person, how long it takes ...)

Victim (what was the driver's feeling with regard to the eCall system)

- Emergency services + questionnaire to the fire brigade

This last table has been created in 2007, following the setting up of a questionnaire sent to the fire brigades (in France) when the call centre called them during an accident.

In France between January 2004 and mid 2011, 2 032 automatic emergency calls were recorded (originating from Peugeot and Citroën cars). 202 calls from vehicles fitted with it have been studied in depth. Our study is based on these 202 accident cases to evaluate the eCall effectiveness, and more particularly the 418 people involved.

Representativeness of the eCall accident database

The "eCall" database is rather new and limited in number of coded cases. Accidents are selected with regard to their relevance (new vehicles, accident typologies). However, it is regularly filled with accident cases whose number increases due to the presence of more and more PSA eCall system in Europe

To evaluate the representativeness of the eCall accident database, we take into account the French national accident statistics. It is representative for accidents involving at least one passenger car without neither pedestrians nor two wheelers. In 2009, there were 67 104 persons involved in an injured accident involving at least one passenger car without neither pedestrians nor two wheelers.

The eCall database is in some ways representative for French accidents. Indeed, we select cases we want to study according to some criteria (single accident, at night, in rural area, with injuries...).

Regarding this comparison, the eCall database is fully representative for the day/night criteria. It is also representative for fatal accidents involving at least one passenger car without neither pedestrians nor two wheelers.

On the contrary, accidents involving only one passengers' car (36.8% compare to 18% for France) or accidents in rural area (59.2% compare to 36.4% for France) are over represented in relation to accidents occurred in France. The eCall database is also over represented for accidents with minor

injuries (56.2% compare to 35.7% for France) and under represented for accidents with serious injuries and with uninjured people. Regarding roads network, the eCall database is largely over represented for the following categories: freeways, state highways and others minors roads (roads predominantly in rural area). Accidents in urban areas are on the contrary, under represented in the eCall database (35% compare to 63.6% for France).

Methodology description

- 1) Carry out accident case samples based on the eCall database with filters like: single vehicle accident, or rural accident, or accident at night or either a combination of 2 or 3 of the previous criteria. We obtain 8 accident typologies (figure 2).

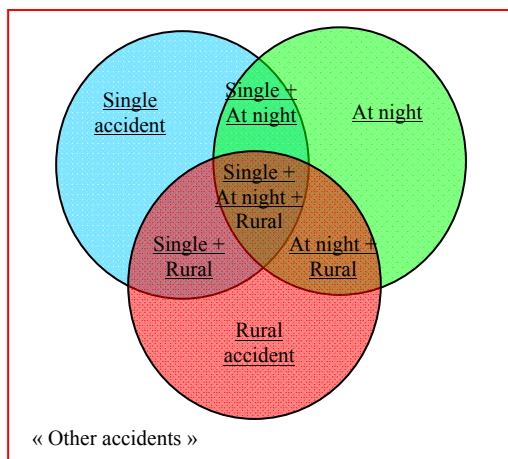


Figure 2. Accident typology distribution

- 2) Study individually each accident cases previously selected.
- 3) Build a template with all accidents typologies defined previously and classify the accident cases according to these criteria. Then make an expert judgment regarding the eCall effectiveness for each accident situations.
- 4) For each previous typology of accidents, calculate the percentage of accident cases where the emergency call is relevant as unnecessary or as useful or as urgent or as vital.
- 5) Calculate the real effectiveness of the emergency call, by multiplying the percentage of injured people with the percentage of cases where the emergency call is considered as relevant (unnecessary, useful, urgent or vital).
- 6) Calculate the number of injured people that eCall can help or save per year in France if 100% of the fleet is equipped with this system.

RESULTS

Sample description

The figure below (figure 3) shows the distribution of the 418 people, according to the 4 specific judgments.

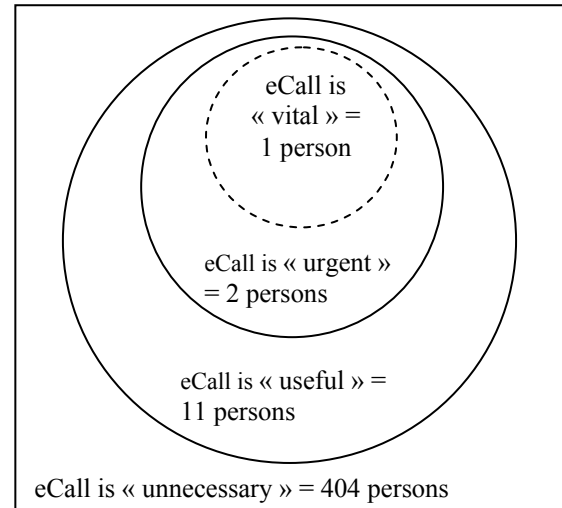


Figure 3. The sharing out of the 418 people according to eCall judgment.

The initial sample is of 418 people is split:

- 103 people are involved in accidents with a single passenger car
- 131 people are involved in accidents with at least one passenger car at night
- 253 people involved in accidents with at least one passenger car in a rural area.

The figure below (figure 4) shows the people distribution according to their accident typologies (single, at night and in rural area) and according to their associated combinations.

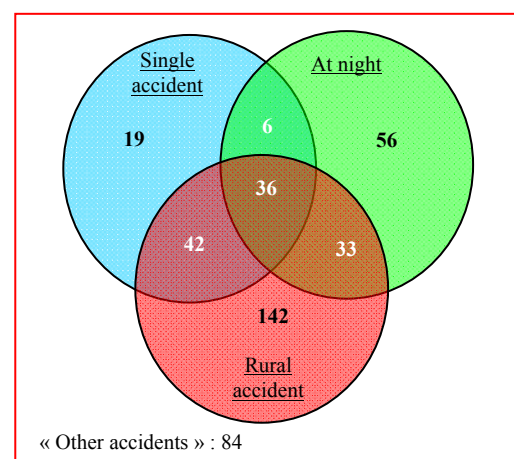


Figure 4. Distribution of people involved in accidents according to their accident typology. Safety benefit calculation when eCall has been judged as “useful”

We need to remind ourselves that the people for whom eCall has been judged as “useful” include people for whom eCall has been judged as “urgent”. And the people for whom eCall has been judged as “urgent” include people for whom eCall has been judged as “vital” (see figure 1). The next figure shows us the percentage of people for whom eCall has been judged as “useful”.

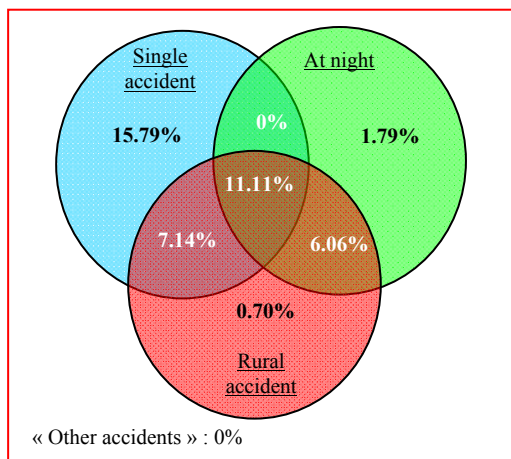


Figure 5. Percentage of people for whom eCall has been judged as “useful”.

Regarding this distribution, eCall appears as more “useful”, with 15.8% efficiency, for accident involving only a single vehicle.

The results of the real efficiency calculation based on the total of person involved in injured accidents are in the figure 5. The global real efficiency is 2.67% based on 67 104 persons involved in injured accidents involving at least one passenger car, without neither pedestrians nor two wheelers (in France in 2009).

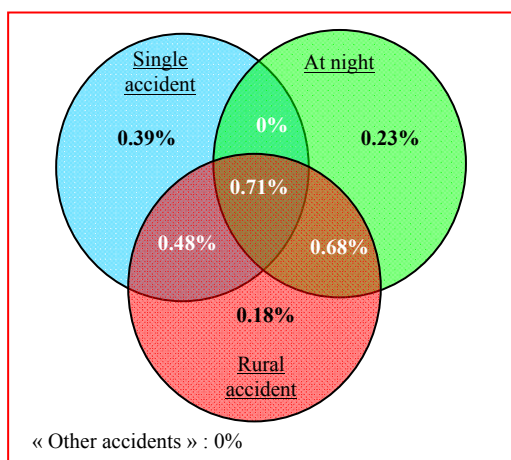


Figure 6.
Real “useful” efficiency calculation: 2.67%

The next step is to calculate the number of people the eCall system would have been able to help.

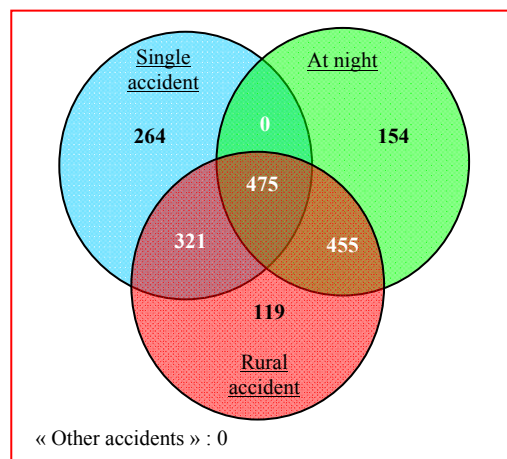


Figure 7. Number of people “helped”: 1 788

Taking into account people for whom the eCall system has been judged “useful”. The figure before (figure 7) shows that 1 788 people would have been helped in 2009 in accidents involving at least one passenger car, without neither pedestrians nor two wheelers.

Safety benefit calculation when eCall has been judged as “urgent” or as “vital”

“Urgent” We apply the same methodology for people for whom eCall has been judged as “urgent”. The results are shown hereafter in figures 8 and 9.

This global real “urgent” efficiency is 0.47% based on 67 104 persons involved in injured accidents involving at least one passenger car, without neither pedestrians nor two wheelers (French national data 2009).

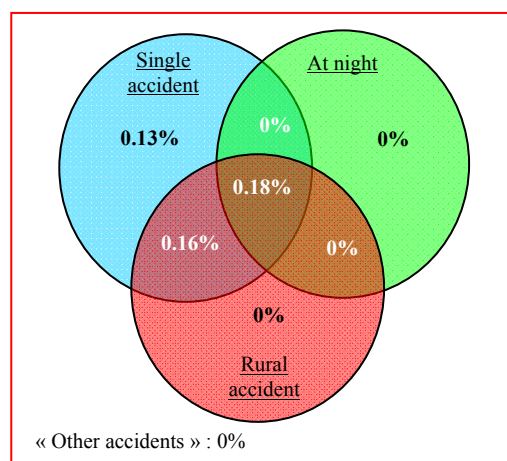


Figure 8.
Real “urgent” efficiency calculation: 0.47%

It means that eCall has avoided the injuries worsening for 314 persons.

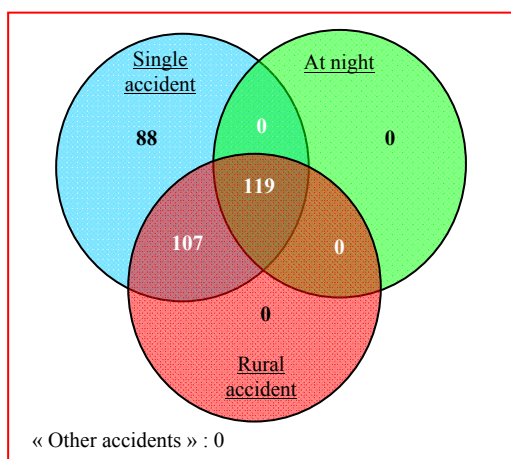


Figure 9.
Number of people judged as “urgent”: 314

“Vital” We apply one more time the same methodology for people for whom eCall has been judged as “vital”. The results are shown hereafter in figures 10 and 11.

In that case, the global real “vital” efficiency is 0.18% based on 67 104 persons involved in injured accidents involving at least one passenger car, without neither pedestrians nor two wheelers (French national data 2009).

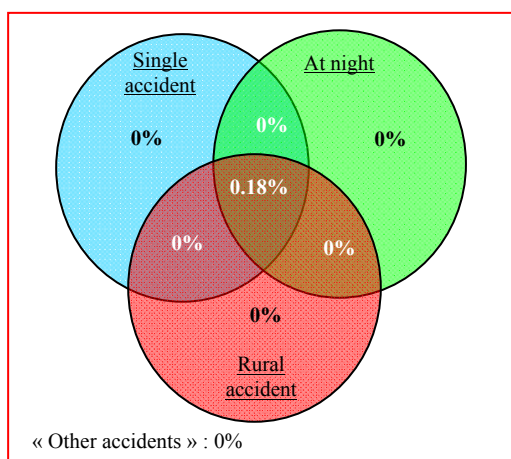


Figure 10.
Real “vital” efficiency calculation: 0.18%

It means that if there were no eCall, 119 persons would have been died because of their injuries.

If we related this last number to the total number of death occurred in France in 2009 (4 273 deaths), the benefit regarding fatalities would be 2.8% for passenger cars with an equipment rate at 100 %.

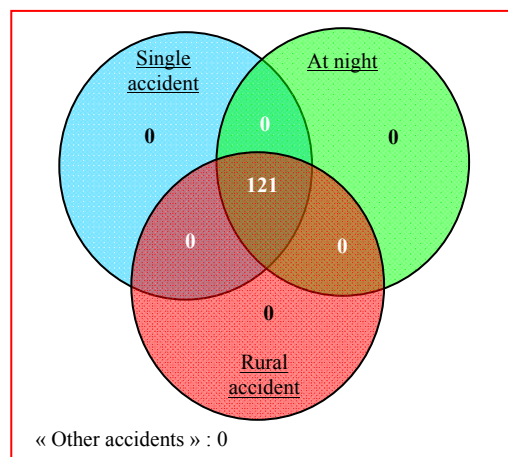


Figure 11.
Number of people judged as “vital”: 119

ECALL EFFECTIVENESS ACCORDING TO OTHER STUDIES

Table 4.
eCall effectiveness according to other studies

Study references	Effectiveness (number of death reduced)	Countries studied
E-Merge [3] [13]	5 – 10%	European Union 15
AINO Study [4] [13]	4 – 8%	Finland
eImpact [5] [13]	3.6% < 5.8% < 7.3%	European Union 25
SEISS [6] [13]	5 – 15%	European Union 25
TRACE [7] [13]	10.80%	Australia
SBD [8] [13]	3%	UK
Erie County ACN field test [9] [13]	20%	USA – New York
Czech eCall study [10] [13]	3 – 9%	Czech Republic
Swedish eCall study [11] [13]	2 – 4%	Sweden
Dutch eCall study [12] [13]	1 – 2%	Netherlands
CEESAR-LAB (“a priori” methodology) [1]	5.1%	France
CEESAR-LAB (“a posteriori” methodology)	2%	France

These studies (table 4) are based on different countries with population, road safety politics and emergency services organisation whose are different one country to another.

The range between the minimum and the maximum of eCall effectiveness calculated is quite large and reaches 19%. Our two studies “*a priori*” and “*a posteriori*” are in the 1st quarter of this range.

CONCLUSIONS

The paper presents an “*a posteriori*” benefit evaluation of an eCall device. This evaluation is unique and for the first time in Europe based on real life case accidents with automatic triggered eCall device. However, we have to take care of the eCall efficiency calculation because our study is based on only 202 accident cases, which means 418 people involved. Whereas the previous study, “*a priori* method”, was based on more than 1 500 fatal accidents reports. Nevertheless, regarding these two studies, we can say that the eCall efficiency is included in an interval between 2.8% and 5%.

This new study allows refining the eCall system effectiveness with a 2.8% benefit. This result based on real world accidentologic data is in the lower range of numerous other international studies done in the past. Besides, this evaluation only concerns passenger cars with an equipment rate at 100 %. All these surveys allow us to define a realistic effectiveness interval of this device between 3% and 10%. It represents a real additional system against road deaths and injuries, in particular for accidents at night in rural areas involving a single vehicle.

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